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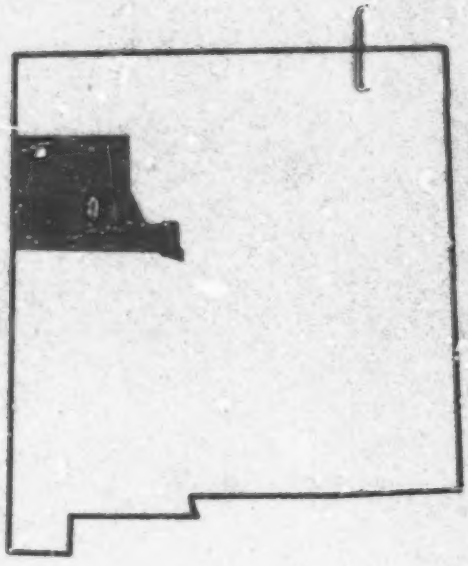
FLOOD INSURANCE STUDY

ORIGINAL

PUEBLO OF ZUNI, NEW MEXICO

McKINLEY AND VALENCIA COUNTIES



SEPTEMBER 4, 1987

Federal Emergency Management Agency

COMMUNITY NUMBER - 350143

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
PUEBLO OF ZUNI, McKINLEY AND VALENCIA COUNTIES, NEW MEXICO

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity flood hazards in the Pueblo of Zuni, McKinley and Valencia Counties, New Mexico, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Bohannan-Huston, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-84-C-1620. This work was completed in October 1985.

1.3 Coordination

Streams requiring detailed study were identified at an initial Consultation and Coordination Officer's (CCO) meeting held July 25, 1983, with representatives of the community, FEMA, and Bohannan-Huston, Inc. (the study contractor).

Results of the hydrologic analyses were coordinated with FEMA, the Soil Conservation Service, the U. S. Geological Survey (USGS), and the U. S. Army Corps of Engineers (COE).

On October 10, 1986, the results of the study were reviewed at a final CCO meeting attended by representatives of the community, the study contractor, and FEMA.

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Pueblo of Zuni, McKinley and Valencia Counties, New Mexico. The area of study is shown on the Vicinity Map (Figure 1).

The Zuni River was studied by detailed methods from approximately 1.4 miles downstream of A 'TS' INA ONA NNE Street to approximately 1.5 miles upstream of State Route 53. Shallow flooding areas between State Route 53 and Eustace Lake, and along A 'TS' INA ONA NNE Street were also studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through October 1990.

The remainder of the Zuni River within the community was studied by approximate methods. In addition, Grasshopper Canyon, Rio Nutria, Bosson Wash, Unit Draw, Coal Mine Canyon, Blind Canyon, Galestina Canyon Creek, Zuni Canal, Oak Wash, Horsehead Canyon, Rio Pescado, Pescado Canyon, Pescado Draw, Trapped Rock Draw, and Peach Orchard Draw were also studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Pueblo of Zuni.

2.2 Community Description

The Pueblo of Zuni is located in west central New Mexico near the Arizona State line, approximately 39 miles south of Gallup, New Mexico. The pueblo is surrounded by the unincorporated areas of McKinley County, New Mexico, to the north and east; the unincorporated areas of Valencia County, New Mexico, to the south and east; and the unincorporated areas of Apache County, Arizona, to the west.

The pueblo is positioned at the base of the Zuni mountains just west of the continental divide. Areas of the Zuni Reservation are located on specified land grants originated by the King of Spain, although the Zuni Indians inhabited the area long before the Spanish Conquistadors appeared in the 1500s. The pueblo has its own system of government and no corporate limits exist within the reservation boundaries. Zuni is a village of over 3,000 people. The natives are highly skilled in silversmithing and produce fine quality jewelry that is easily distinguished. Farming is the basic way of life, and corn is the principal crop.

Major development in the pueblo area is minimal and no significant development affecting the floodplain is anticipated within the next five years. However, the Zuni River is closely bordered by numerous stone and adobe structures, of which some are of historical significance.

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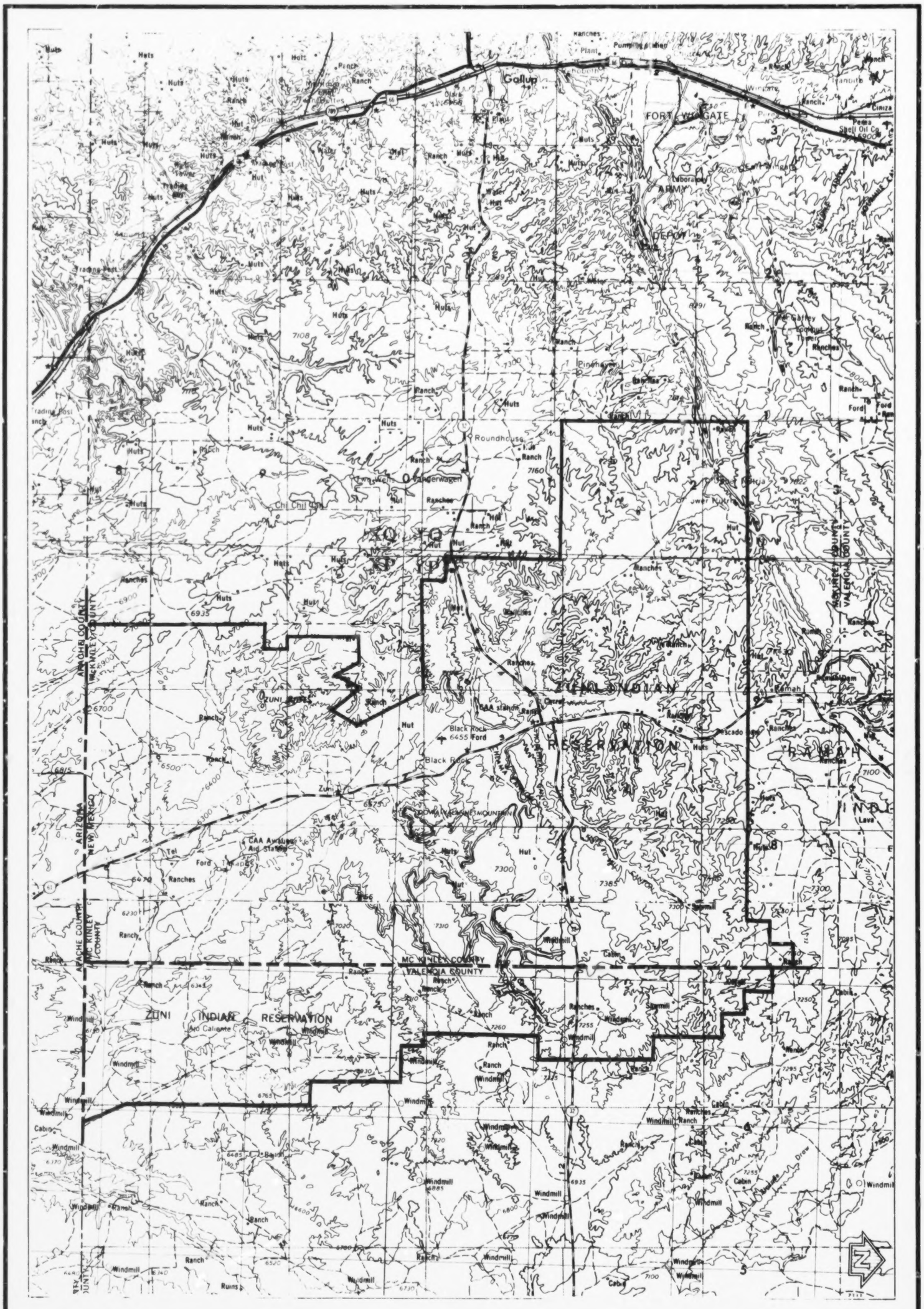
Gallup
FORT WINGATE
DEPOT
Roundhouse
Chi Chil Tah
ZUNI
Black Rock
6455 Ford
Black Rock
RESERVATION
ZUNI INDIAN
RESERVATION
ZUNI INDIAN
Ojo Caliente
RESERVATION
MC KINLEY COUNTY
VALENCIA COUNTY
APACHE COUNTY
MC KINLEY COUNTY
ARIZONA
NEW MEXICO
CAA Airways Aid Station
CAA station
Ranches
Huts
Ranch
Windmill
Cabin
Ruins
Trading Post
Pumping Station
Plant
Laboratory
Army
Lava
Pinta
Cinza
Shell Oil Co.
Texas
Ford
To
Gallup
Ramah
Cascado
Jones
Dam
Reservoir
Valley
Spring
Tanks
Corral
Tank
Wash
Creek
Mountain
Hill
Butte
Mesa
Draw
Gap
Trail
Road
Highway
Ford
Bridge
Tel
Line
Power
Pipe
Fence
Boundary
Survey
Monument
Section
Township
Range
Meridian
Base
Line
Corner
Post
Office
Store
School
Church
Cemetery
Hospital
Clinic
Dispensary
Library
Museum
Park
Recreation
Area
Camp
Ground
Picnic
Area
Golf
Course
Swimming
Pool
Tennis
Court
Baseball
Field
Football
Field
Basketball
Court
Volleyball
Court
Track
Field
Stadium
Arena
Auditorium
Theater
Hotel
Motel
Restaurant
Cafe
Bar
Tavern
Liquor
Store
Grocery
Store
Gas
Station
Service
Station
Garage
Repair
Shop
Auto
Dealer
Truck
Dealer
Implement
Dealer
Feed
Store
Lumber
Yard
Hardware
Store
Drug
Store
Bank
Post
Office
Courthouse
Jail
Fire
Station
Police
Station
Sheriff
Office
Town
Hall
City
Hall
County
Seat
Capital
Airport
Landing
Strip
Helipad
Heliport
Seaplane
Base
Marina
Boat
Ramp
Dock
Pier
Wharf
Lighthouse
Beacon
Tower
Water
Tower
Windmill
Well
Spring
Reservoir
Tank
Pond
Lake
River
Creek
Stream
Wash
Arroyo
Gulch
Canyon
Valley
Mountain
Hill
Butte
Mesa
Plateau
Ridge
Pass
Gap
Trail
Road
Highway
Bridge
Ford

The Zuni River watershed encompasses approximately 950 square miles upstream of the pueblo, including 150 square miles considered as non-contributing. The non-contributing area lies in the most upstream portion of the basin between the Town of El Morro and the Continental Divide. This area is considered to be non-contributing due to the nearly flat slopes and numerous small closed basins. There are many small stock ponds and reservoirs in the contributing basin, the largest being Black Rock Reservoir, located approximately 4 miles upstream of the Pueblo of Zuni. Elevations in the watershed range from over 9,000 feet in the Zuni mountains to 6,250 feet at the west end of the study area. Slopes of the streams vary from 3 percent in the mountain areas to less than 0.5 percent near the Pueblo of Zuni.

The Zuni River flows intermittently with periods of zero flow along some reaches of the river. Rio Pescado and Rio Nutria are the largest tributaries on the Zuni River. Several springs supply perennial flows to reaches of these streams above the Pueblo of Zuni. Vegetation in the floodways consists mainly of marsh grasses and brush with some areas of mature trees. In the upstream reaches of the study, the river is well incised; however, the lower reaches, west of the pueblo, consist of broad, flat floodplains showing evidence of previous braid and meander patterns.

2.3 Principal Flood Problems

Mountain springs and summer thunderstorms are the primary source of water for the Zuni River. Flood stages are generally produced as a result of intense cloud bursts that occur most frequently during the months of July through September. Occasionally, storms occurring in February have produced yearly peak flows.

Mean annual precipitation averages 12 inches but is subject to variation with some long dry periods. Rainfall patterns in the area are hard to predict "due to the nature of the country and the peculiar conditions of heavy rains in one section and no precipitation in others a few miles distant" (Reference 1).

Very little historical information is available on past flooding of the Zuni River. The five largest known discharges are shown in Table 1, "Five Maximum Known Flows on Zuni River."

TABLE 1 - FIVE MAXIMUM KNOWN FLOWS ON ZUNI RIVER

DATE	PEAK DISCHARGE (cfs)	ELEVATION* (in feet)	STAGE* (ft.)
1905	14,000**	6,305.9	13.0
8/4/74	5,200	6,301.8	8.9
8/24/82	4,160	6,299.7	6.8
8/20/76	3,310	6,298.6	5.7
8/18/83	2,560	6,297.4	4.5

* At upstream side of State Route 53, based on 1985 conditions.
**Flow estimated for gage above Black Rock Reservoir

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The maximum known peak flow for the Zuni River occurred in 1905. The discharge of 14,000 cfs is estimated for the gage above Black Rock Reservoir. Near the pueblo, the flow would have been approximately 15,000 cfs. This flood of 1905 is estimated to have a recurrence frequency of approximately 180 years.

The largest discharge of recent record occurred August 4, 1974. The flow of 5,200 cfs produced from this storm has an estimated frequency of occurrence of 12 years.

On August 18, 1983, some damages occurred in the pueblo area due to a flow of 2,560 cfs. The estimated frequency of this discharge is 4 years.

There are two major structures that cross the Zuni River in the area studied by detailed methods. Descriptive structural information for these two structures is given in Table 2, "Pueblo of Zuni Major Bridges." Both crossing structures cause a backwater effect on the Zuni River for flows greater than 50-year frequency. The structure at A 'TS' INA ONA NNE Street and the general geometry of the area produces a large constriction in the river that will cause flows to backup behind the road, thus flooding the buildings near the river banks.

TABLE 2 - PUEBLO OF ZUNI MAJOR BRIDGES

LOCATION	STREAM	TYPE	MAXIMUM ROADWAY ELEVATION (NGVD)	TOTAL CLEAR WIDTH (ft.)
State Route 53	Zuni River	Concrete Box Culvert	6,304.1	80
A 'TS' INA ONA NNE Street	Zuni River	Concrete Arch Slab	6,276.3	186

Eustace Dam, located upstream of State Route 53, causes local flooding of the Zuni River. The principal spillway has very little capacity, thus causing flows to circumvent the embankment to the north and south. The embankment itself does not have sufficient freeboard and will probably fail in large flows. In addition, since the reservoir has little storage capacity due to sedimentation, embankment failure would not produce flood waves much larger than the peak inflows entering the reservoir during flood stages.

Photographs exhibiting existing conditions and potential 100-year flood elevations at the State Route 53 crossing and the Eustace Dam spillway are shown in Figures 2 and 3.

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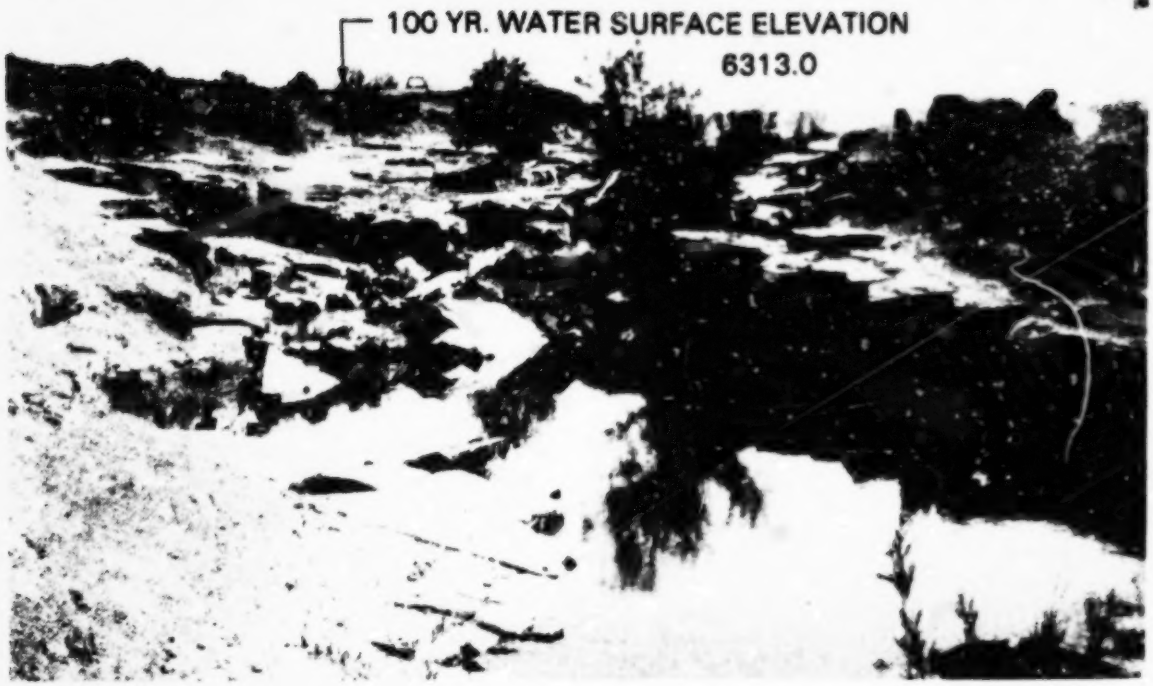

Figure 2 - Existing conditions and potential 100-year flood elevation at Eustace Dam spillway.

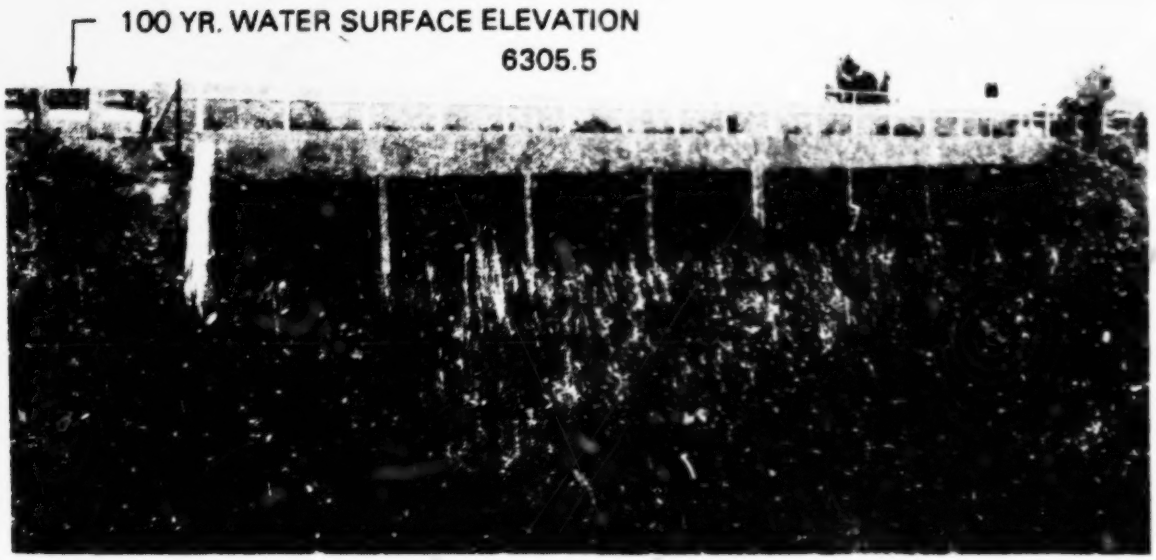

Figure 3 - Existing conditions and potential 100-year flood elevation at State Route 53 crossing on the Zuni River looking downstream.

2.4 Flood Protection Measures

Levees have been constructed on the north and south banks of the Zuni River below the A 'TS' INA ONA NNE bridge. The levees are approximately 2,000 feet long and 4 to 8 feet high. Protection from flooding is provided by these levees for less than the 20-year frequency flows. FEMA specifies that all levees must have a minimum of 3 foot freeboard against 100-year flooding to be considered a safe flood protection structure. However, the levees in this study do not meet the FEMA 3-foot minimum freeboard criteria along their lengths for flows larger than 20-year storm and the embankments do not appear to be well maintained. Therefore, the levees have been assumed to fail for purposes of this study.

There are no other riverine structures on the Zuni River in the study area providing flood protection during major flows. Black Rock Reservoir will only give some flood protection under low flows. The storage capacity of the reservoir has been severely reduced by sedimentation since its construction and, therefore, no significant protection is provided for large flows. For study purposes, Black Rock Reservoir was assumed to have no effect on the Zuni River discharges. There are several other small dams within the community, including the previously mentioned Eustace Dam. These are considered to have minimal flood protection impact.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

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3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied in detail affecting the community.

Discharges for the Zuni River were based on 14 years of systematic record from the gaging station "Zuni River above Black Rock Reservoir, New Mexico" (Station No. 09386950) and a 1905 historic peak computed by the Bureau of Reclamation (References 2 and 3). Frequency discharges for the gage were computed using log-Pearson Type III analysis with historic weighting (Reference 4). Flows were transferred from the gage to points within the study area using a graphical technique based on drainage areas and the regression equations developed by the USGS (Reference 5).

For study purposes, two different discharges were determined for each frequency on the reaches of the Zuni River above and below Calestina Canyon.

A summary of the drainage area-peak discharge relationships for the Zuni River is shown in Table 3, "Summary of Discharges."

TABLE 3 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ZUNI RIVER					
Downstream of confluence with Galestina Canyon Creek	812	5,100	9,800	12,300	19,300
Upstream of confluence with Galestina Canyon Creek	708	4,800	9,300	11,700	18,400

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analyses of the detailed study area were obtained from field surveys and topographic mapping at a scale of 1:2,400 and a contour interval of 2 feet (Reference 6). All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

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Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 7). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the Zuni River were determined based on normal depth.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness values for the main channels in the study area ranged from 0.025 to 0.050, while overbank roughness values ranged from 0.030 to 0.050 for all floods.

The approximate boundaries for portions of Galestina Canyon Creek, Oak Wash, Trapped Rock Draw, and Peach Orchard Draw were determined by normal depth calculations.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 2 feet (Reference 6). The shallow flooding areas were delineated using topographic maps (Reference 6).

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For portions of Galestina Canyon Creek, Oak Wash, Trapped Rock Draw, and Peach Orchard Draw, the 100-year floodplain boundary was delineated using topographic maps at a scale of 1:2,400 with a contour interval of 2 feet (Reference 6). For the remaining portions of those streams and all other streams studied by approximate methods, the flood boundaries were taken directly from the Flood Hazard Boundary Map for the Pueblo of Zuni (Reference 8).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and AO), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data. For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 4). The computed floodway is shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Zuni River								
A	5,075	430	2,046	6.0	6,254.9	6,254.9	6,255.7	0.8
B	5,865	450	1,595	7.7	6,258.1	6,258.1	6,258.9	0.8
C	7,140	700	2,943	4.2	6,262.0	6,262.0	6,262.7	0.7
D	9,890	545	1,822	6.7	6,264.5	6,264.5	6,265.4	0.9
E	11,095	600	3,507	3.5	6,267.5	6,267.5	6,268.2	0.7
F	11,575	600	2,829	4.3	6,267.9	6,267.9	6,268.8	0.9
G	12,035	300	1,111	11.1	6,268.6	6,268.6	6,269.1	0.5
H	12,295	295	1,254	9.8	6,271.8	6,271.8	6,272.1	0.3
I	12,595	200	1,385	8.9	6,274.1	6,274.1	6,274.1	0.0
J	13,360	300	2,078	5.9	6,274.7	6,274.7	6,275.2	0.5
K	14,050	430	1,781	6.9	6,275.4	6,275.4	6,276.3	0.9
L	14,555	350	1,934	6.4	6,277.2	6,277.2	6,277.8	0.6
M	15,295	400	2,400	5.1	6,278.2	6,278.2	6,279.0	0.8
N	16,388	500	1,778	6.9	6,280.2	6,280.2	6,280.8	0.6
O	17,235	500	2,632	4.7	6,282.1	6,282.1	6,282.9	0.8
P	18,675	300	1,565	7.5	6,283.8	6,283.8	6,284.8	1.0
Q	18,975	350	2,198	5.3	6,285.1	6,285.1	6,285.9	0.8
R	19,720	200	941	12.4	6,287.8	6,287.8	6,288.1	0.3
S	20,475	240	1,452	8.1	6,292.3	6,292.3	6,292.8	0.5

[1] Feet above Reservation Route 40

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

PUEBLO OF ZUNI, NM

(McKINLEY AND VALENCIA COUNTIES)

FLOODWAY DATA

ZUNI RIVER

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Zuni River (continued)								
T	21,155	270	1,636	7.2	6,293.9	6,293.9	6,294.6	0.7
U	21,800	280	1,748	6.7	6,294.9	6,294.9	6,295.8	0.9
V	22,305	230	1,357	8.6	6,295.9	6,295.9	6,296.6	0.7
W	23,075	250	1,724	6.8	6,297.7	6,297.7	6,298.7	1.0
X	23,835	250	1,980	5.9	6,299.5	6,299.5	6,300.1	0.6
Y	23,875	240	3,187	3.7	6,305.5	6,305.5	6,306.5	1.0
Z	23,955	240	3,307	3.5	6,306.0	6,306.0	6,307.0	1.0
AA	24,575	240	3,017	3.9	6,306.2	6,306.2	6,307.2	1.0
AB	26,325	340	2,242	5.2	6,313.9	6,313.9	6,314.8	0.9
AC	27,210	350	2,522	4.6	6,314.6	6,314.6	6,315.6	1.0
AD	28,045	260	1,936	6.0	6,315.5	6,315.5	6,316.3	0.8
AE	28,975	160	1,359	8.6	6,316.9	6,316.9	6,317.2	0.3
AF	31,075	220	1,718	6.8	6,320.7	6,320.7	6,321.4	0.7
AG	31,855	195	1,611	7.3	6,323.5	6,323.5	6,324.2	0.7

[1] Feet above Reservation Route 40

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

PUEBLO OF ZUNI, NM

(McKINLEY AND VALENCIA COUNTIES)

FLOODWAY DATA

ZUNI RIVER

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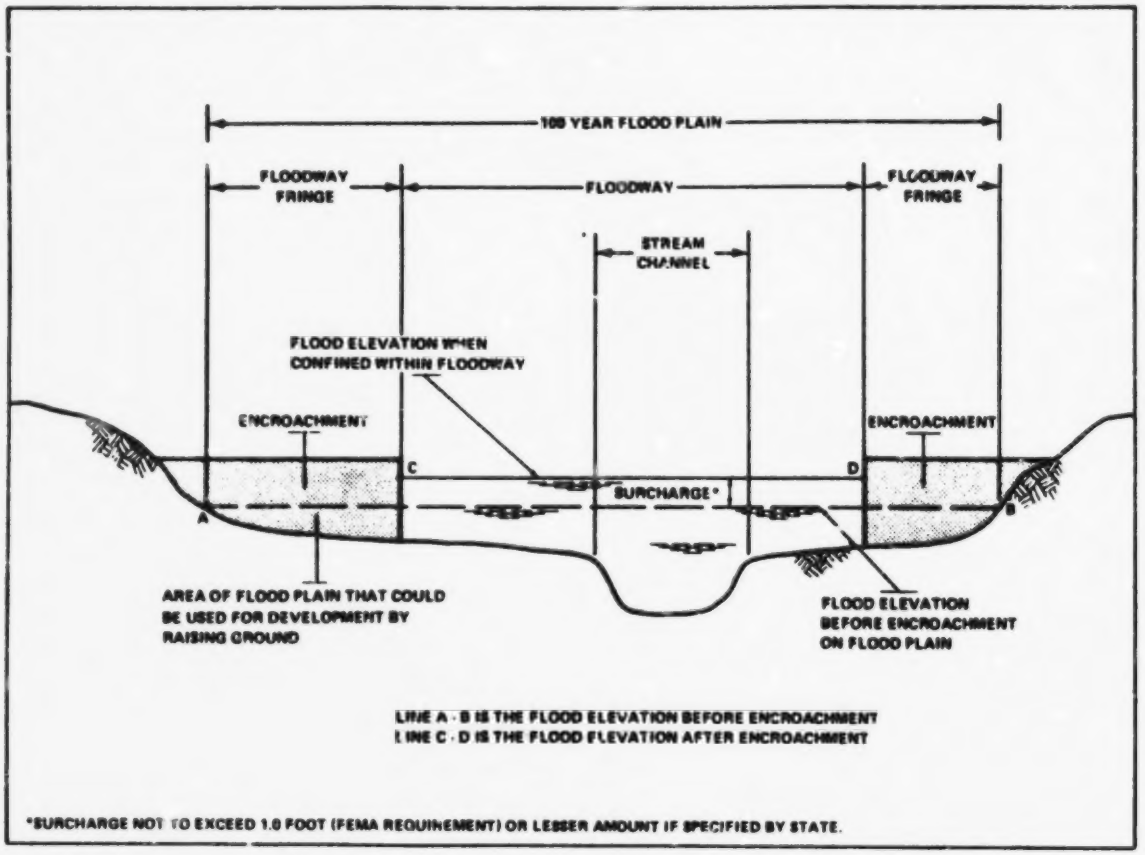
The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 4

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

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Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are

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less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

A Flood Insurance Study for the unincorporated areas of Apache County, Arizona, has been published (Reference 9). The results of this study are in complete agreement with the results of the Apache County study.

Due to its more detailed nature, this Flood Insurance Study supersedes the Flood Hazard Boundary Map for the Pueblo of Zuni, New Mexico (Reference 8).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Federal Regional Center, 800 North Loop 288, Denton, Texas 76201.

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9.0 BIBLIOGRAPHY AND REFERENCES

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2. U. S. Department of the Interior, Geological Survey, USGS Data Retrieval System, WATSTORE - Peak Flow File, Computer Program #J980, Washington, D.C., 1985.

3. Water and Power Resources Service, Lower Colorado Regional Office, Bureau of Reclamation, 1-23-1980, obtained from U. S. Army Corps of Engineers, Los Angeles District Hydrology Branch, Frequency Analysis Zuni Project, New Mexico (Unpublished).

4. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.

5. U. S. Department of the Interior, Geological Survey, Water Resources Investigations 82-24, Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico, Albuquerque, New Mexico, March 1982.

6. Bohannon Huston, Inc., of Albuquerque, New Mexico, Topographic Maps, Scale 1:2,400, Contour Interval 2 Feet: Zuni, New Mexico, 1974.

7. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Users Manual, Davis, California, November 1976, with updates.

8. Federal Emergency Management Agency, Federal Insurance Administration, Flood Hazard Boundary Map, Pueblo of Zuni, McKinley and Valencia Counties, New Mexico, Washington, D.C., March 18, 1980.

9. Federal Emergency Management Agency, Flood Insurance Study, Apache County, Arizona, Washington, D.C., July 5, 1982.

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EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	130	6,276.5	A 'TS' INA ONA NNE bridge at Zuni River, top of concrete pedestal on southeast bridge corner; chiseled square with X.
RM 2	130	6,287.7	Approximately 400 feet north of Village Loop Road, west of Galestina Canyon Creek, set 5/8 inch rebar with red plastic cap marked Weaver LS6544.
RM 3	130	6,344.3	Approximately 450 feet north of Village Loop Road on hill; 3-inch brass cap in concrete marked Bohannan Westman Huston Inc., HV-10A.
RM 4	130	6,304.1	State Route 53 box culvert at Zuni River, southeast wing wall corner, chiseled square with X.
RM 5	135	6,322.4	Approximately 100 feet south of Village Loop Road, 5/8 inch rebar with cap marked LS2455.

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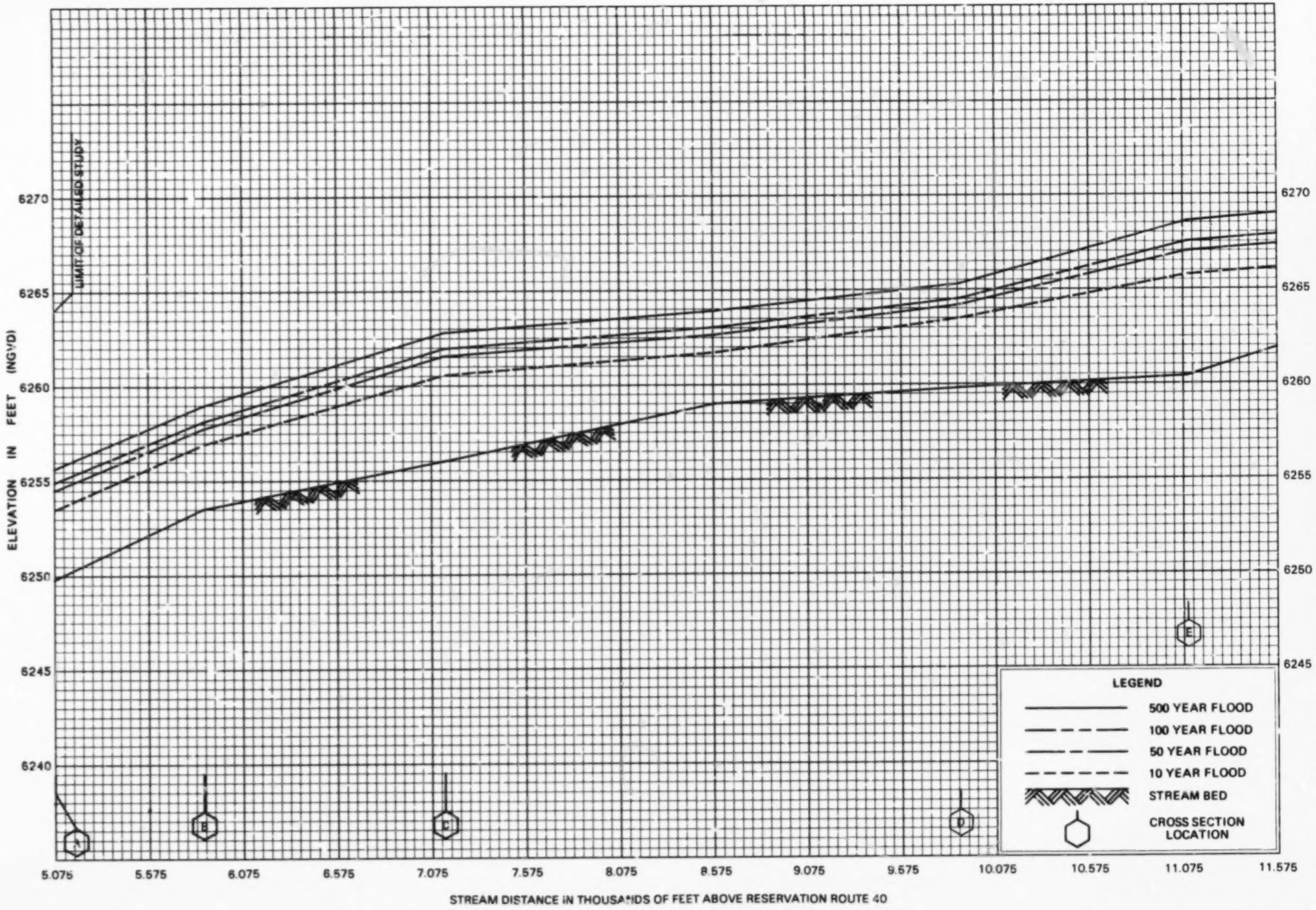

FLOOD PROFILES

ZUNI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

PUEBLO OF ZUNI, NM
(McKINLEY AND VALENCIA COUNTIES)

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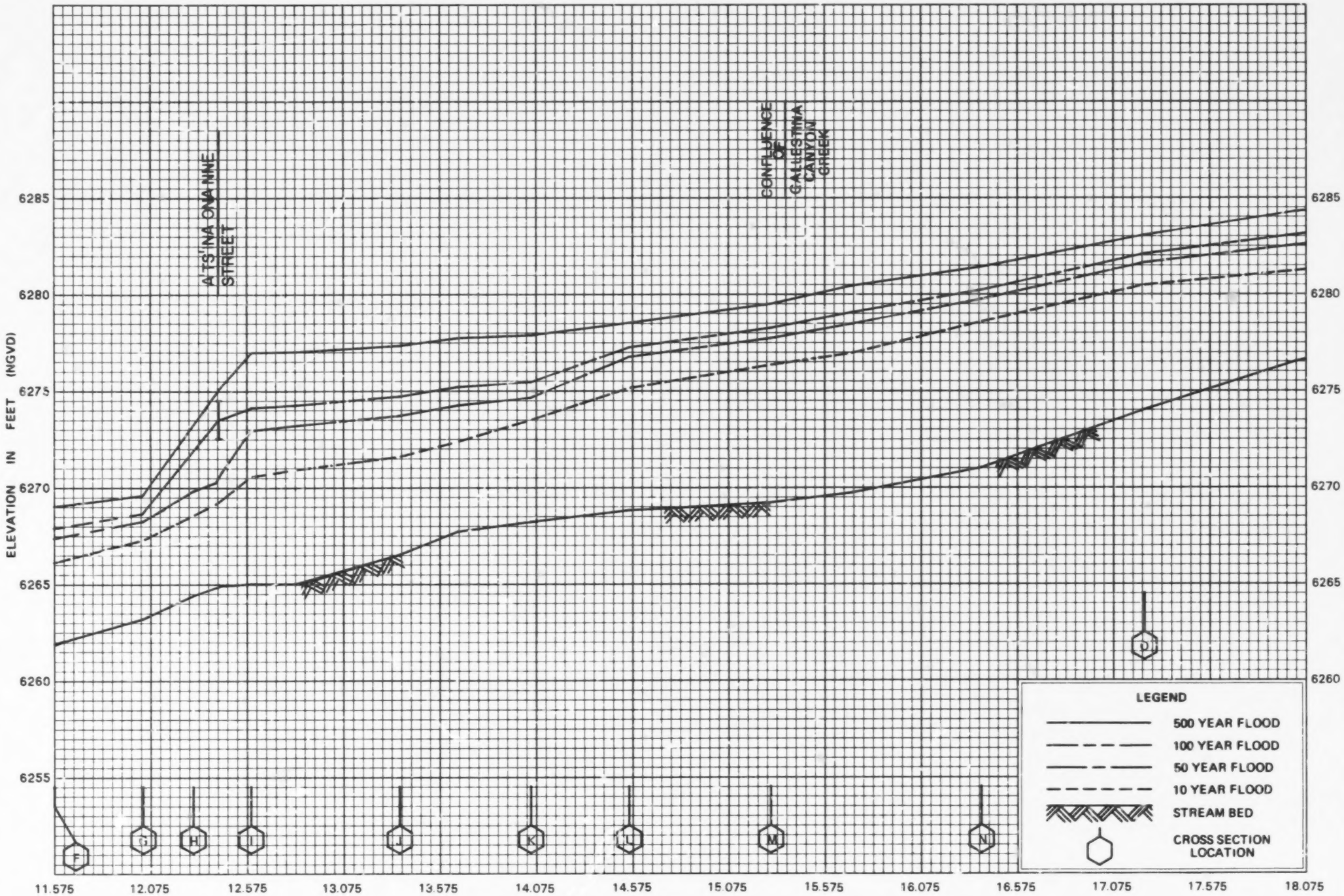

FLOOD PROFILES

ZUNI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

PUEBLO OF ZUNI, NM
(McKINLEY AND VALENCIA COUNTIES)

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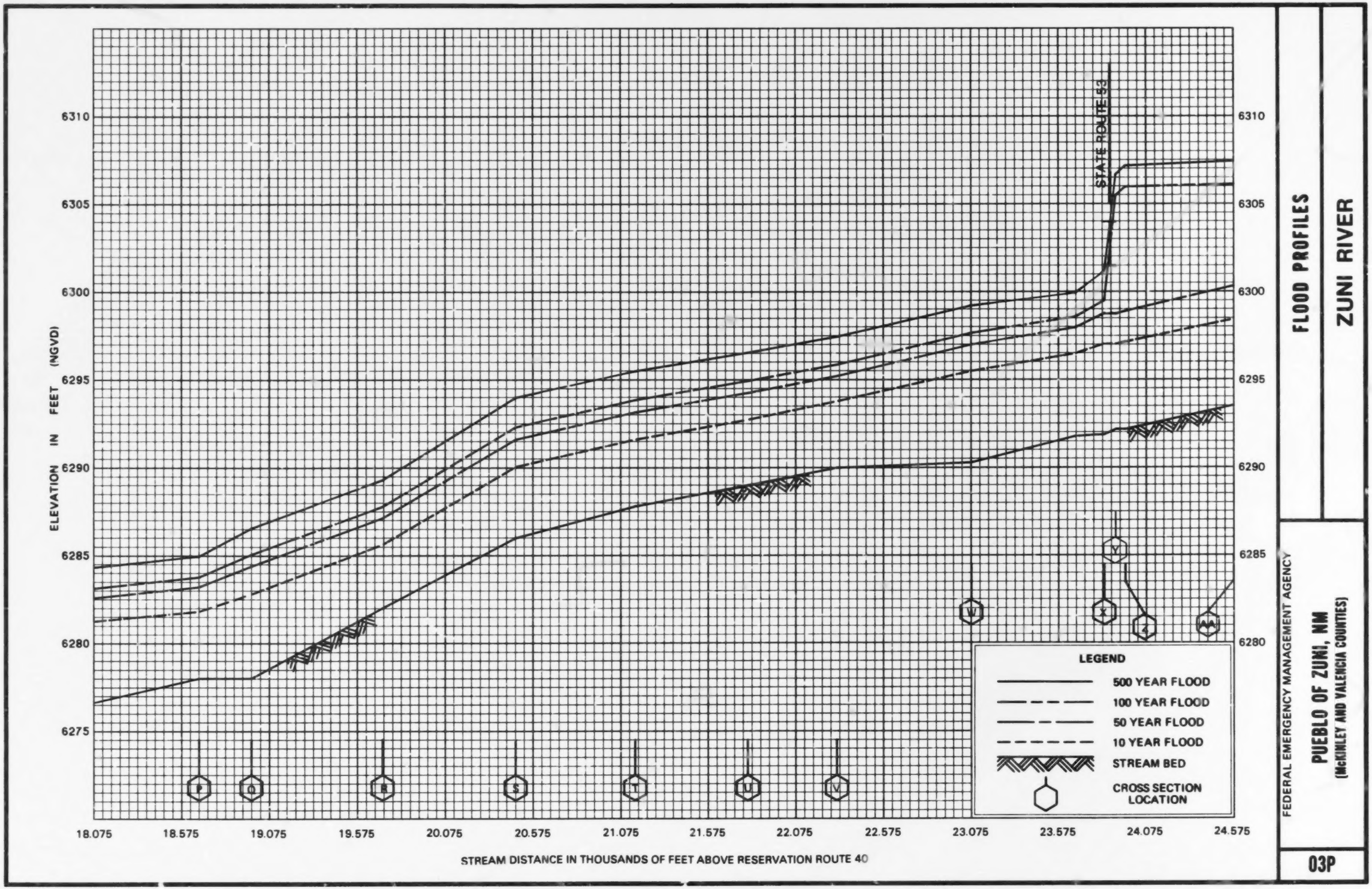

FLOOD PROFILES

ZUNI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

PUEBLO OF ZUNI, NM
(McKINLEY AND VALENCIA COUNTIES)

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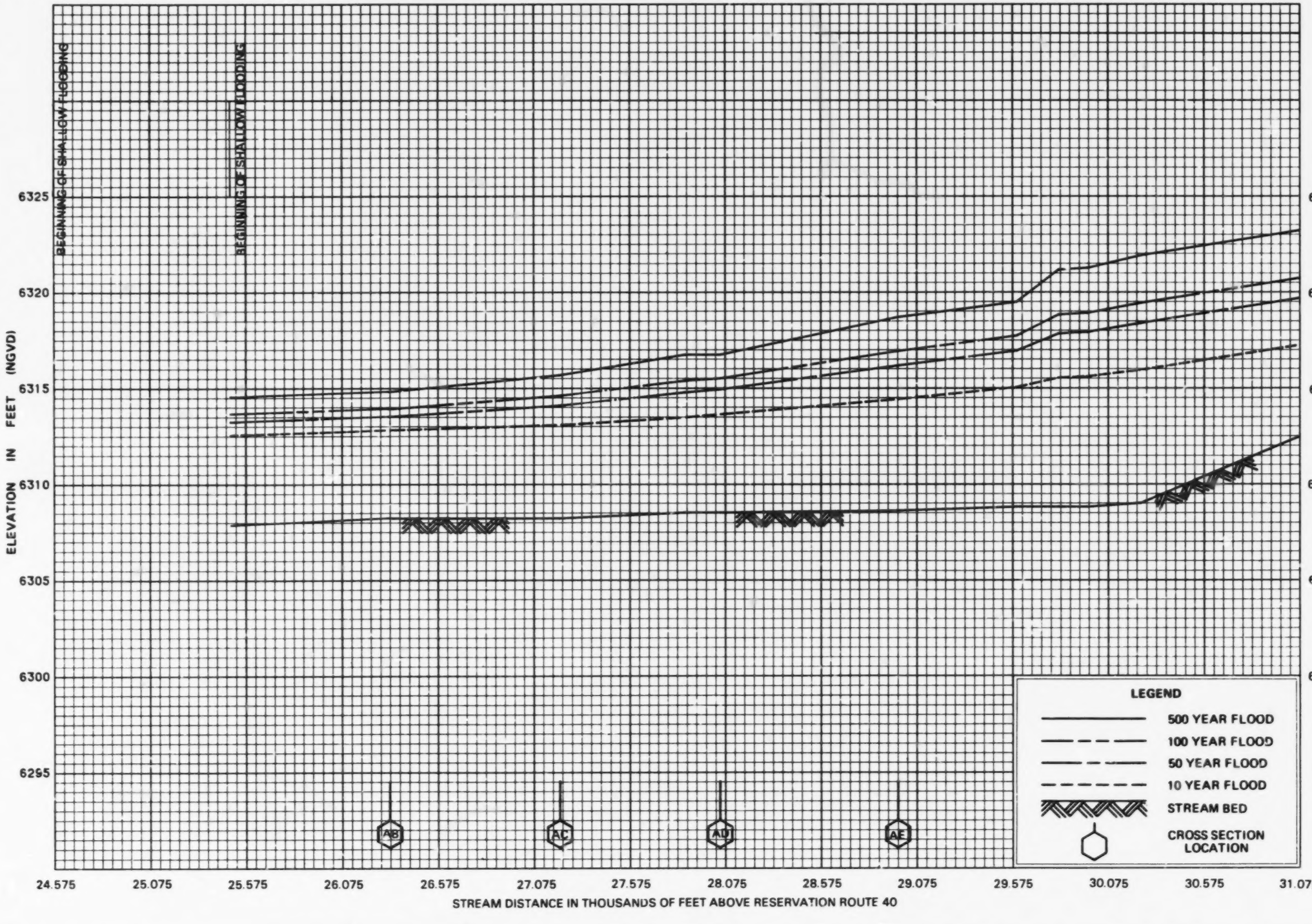

FLOOD PROFILES

ZUNI RIVER

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